APPLICATION FOR U.S. PATENT

Inventor: Bernd Schulze.

Invention: HOLLOW MOLDED PART WITH CLOSED CROOS-SECTION AND A[illegible] REINFORCEMENT

Attorney's Docket Number: RUM223

Horst M. Kasper, their attorney
13 Forest Drive, Warren, N.J. 07059
Tel. (908)526 1717; Reg. No. 28559
Attorney's Docket No.: RUM223

HOLLOW MOLDED PART WITH CLOSED CROSS-SECTION AND A REINFORCEMENT

BACKGROUND OF THE INVENTION

1. Field of the Invention

The Invention relates to a hollow molded part made of a metallic material produced by inner high pressure metal forming out of a mold blank, wherein the hollow molded part exhibits a closed cross-section and a reinforcement according to the preamble of the first Patent claim.

2. Brief Description of the Background of the Invention Including Prior Art

A vehicle structural member or, respectively, a hollow molded part with closed cross-section is known from the German printed Patent document DE 19518946 A1, wherein the vehicle structural member or, respectively, the hollow molded part is formed with at least two component parts connected to each other. The term closed cross-section is associated with the circumference of the hollow mold part closed in itself. This hollow molded part represents a front column or, respectively, an A-

column of a motor vehicle body and is formed out of an outer plate, a column stiffening and an inner column made of light metal. The reinforcement element is here disposed within the region of the closed cross-section of the vehicle structural member. It is furnished to attach several individual elements, such as for example pipes, plates, or the like along the hollow reinforcement element for further increasing the strength.

A solution is described in the German printed Patent document DE 10126183 A1, wherein a stiffening element is disposed in the inner chamber of the hollow molded part, wherein the stiffening element is connected to the hollow molded part and wherein the stiffening element extends through a recess of the hollow molded part into the inner space of the hollow molded part. The frame structure of a vehicle is described in the German printed Patent document DE 20 20 6524 U1, wherein a tubular frame part is furnished and wherein a sheet metal component part is furnished at the outer circumference of the tubular frame part for reinforcement of the frame structure. The disadvantage of this solution comprises the multipart construction and the therewith associated high production expenditure.

The body of a motor vehicle is described in the German printed Patent document DE 4106501 A1, wherein a part of the supporting structure of the body is composed

out of two extruder profiles open relative to each other, and wherein the extruder profiles exhibit a closed cross-section after a connection to each other. The extruder profiles are here weight optimized based on shape and wall thickness corresponding to the expected requirements as to stiffness. The multiple part construction of the respective frame part is here also disadvantageous.

SUMMARY OF THE INVENTION

1. Purposes of the Invention

It is an object of the Invention to develop a hollow molded part with a closed cross-section and a reinforcement, which can be produced out of a minimum number of component parts.

These and other objects and advantages of the present invention will become evident from the description which follows.

2. Brief Description of the Invention

The present invention provides a hollow part with closed cross-section and a reinforcement.

This object is accomplished with the features of the first Patent claim and further features result from the subclaims. The hollow molded part made of a metallic material, which hollow molded part is produced out of a mold blank by inner high pressure metal forming and exhibits here a closed cross-section and a reinforcement and is formed as a single part with the reinforcement.

Here a blank mold is generated having a first region, wherein the first region exhibits a first starting outer diameter and a starting wall thickness and with at least one second region reduced relative to the starting outer diameter, wherein the second region exhibits an increased wall thickness relative to the starting wall thickness, wherein the region of the increased wall thickness forms the reinforcement.

The second region is here preferably conically formed. A third region with reduced diameter can follow to the second region, wherein the third region then also exhibits an increased wall thickness in comparison to the starting wall thickness.

The second conical region and as far as present also the third region are reduced in their diameter here by a radial or tangential deformation method in comparison to the first region. This is accomplished preferably by hammering, forging, rotary kneading, swaging, rolling, flow turning or stretch forming.

It is also possible that a conical second region and a region reduced in diameter follow right and left mirror imaging to the first region with the larger outer diameter or that a region reduced in diameter is disposed in the middle, wherein a conical region with following increased starting diameter follows on two sides to the region reduced in diameter and disposed in the middle.

The hollow molded part is preferably bent in the second conical region for production of for example an A-column of a vehicle body.

It is for the first time possible based on the wall thickness increase in the reduced region to produce a single part frame part with reinforcement. A blank mold is generated by rotary kneading out of a tubular starting part with a starting wall thickness for production of for example an A-column, wherein the blank mold exhibits a region with an a starting diameter, a conical region (narrowing in diameter) and a cylindrical region following and having a reduced diameter, wherein the wall thickness is increased in the conical region and in the diameter reduced region relative to and in comparison with the starting wall thickness. The mold blank is in the following bent in the conical region (preferably subject to axial tensile stress).

Finally the A-column is produced by inner high-pressure metal forming. Several intermediate deformation stages can be performed prior to the bending and/or prior to the inner high-pressure metal forming. It is also possible to intermediately anneal the in part produced workpiece prior to the inner high-pressure metal forming.

Larger loads in the crash case can be taken based on the increased wall thickness in the conical region also with single part formation.

It is also possible with the construction according to the present Invention to produce for example longitudinal carriers, frame parts, axial bodies and gear parts, wherein an increased wall thickness or, respectively, reinforcement in certain regions of these could be achieved up to now only by multipart construction, wherein consideration is given to increased load requirements in particular in the narrowing region of the mold blank or of the therefrom generated hollow mold part based on the increased wall thickness.

The advantages of an increased strength and an increased wall thickness in the deformation region, of a relative smooth surface, of a favorable course of the fibers, as well as of time savings and material savings appear by employing round kneading,

where round kneading is a chipless and shavingless deformation process for reducing the cross-section of rods, tubes and wires.

The materials employed for production of the hollow mold part according to the present invention include steel, stainless steel, non-iron metals and/or alloys.

The Invention is illustrated in more detail in the following based on the embodiment examples and associated drawings.

The novel features which are considered as characteristic for the invention are set forth in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

In the accompanying drawing, in which are shown several of the various possible embodiments of the present invention:

There is shown in:

Figure 1: a side elevational view of a tubular starting part for production of a hollow molded part in the shape of an A-column,

Figure 2: a sectional view of a mold blank for production of a hollow molded part in the shape of an A-column,

Figure 3: blank mold for production of an axle,

Figure 4: an axle produced from a blank mold by an inner high-pressure metal forming process.

Figure 1 shows the tubular starting part A with a starting outer diameter D1, which tubular starting part A serves for example for production of an A-column of a vehicular body. A mold blank for further production of the hollow molded part in the shape of an A-column was generated for example by rotary kneading in a round kneading machine according to figure 2. The A-column exhibits a cylindrical first region 1 with the length L1, wherein the diameter of the cylindrical first region 1 corresponds to the starting outer diameter D1 and which first region 1 has a starting wall thickness b1. There follows a second region 2 of a length L2, wherein the outer diameter reduces conically up to the outer diameter D2. The angle α depends here

on the starting outer diameter D1, on the outer diameter D2 and on the length L2 of the region 2. The following third region is formed cylindrical and is reduced to the diameter D2 over a length L3. The wall thickness b2 of the following third region 3 and also the wall thickness not designated in detail for the second region are increased in comparison to the starting wall thickness b1. The wall thickness of the second region corresponds to the wall thickness b1 or, respectively, b2 in the transition areas to the regions 1 or, respectively, 3.

The mold blank is now bent according to the required curvature of the A-column, wherein the bending radius is disposed in the second region (not illustrated). Finally, the final forming of A-column is performed by inner high-pressure metal forming. Several intermediate deformation stages can be performed previously and possibly an annealing treatment can be performed. The finished A-column exhibits now in the region of the bending (previously region 2) and in the following region directed toward the roof of the vehicle (previously region 3) an increased wall thickness, wherein the increased wall thickness operates as a reinforcement and whereby further internally disposed or from the outside applied additional reinforcement parts can be dispensed with.

The dimensions of the mold blank can assume thereby the following dimensions:

- starting diameter D1: from about 80 mm to 160 mm,
- outer diameter D2: from about 0.4 to 0.7 times the size of the starting diameter D1,
- starting wall thickness b1: from about 2.0 mm to 5.0 mm,
- wall thickness b2: from about 0.4 to 0.7 divided by the starting wall thickness b1,
- length L1: from about 1000 mm to 2500 mm,
- length L2: from about 200 to 1000 mm,
- length L3: from about 500 mm to 1500 mm, and
- angle α = f(L2, D2, D1) = from about 10 degrees to 85 degrees.

It is to be noted at this point that in addition to the recited dimensions also mold blanks or, respectively hollow mold parts can be produced having a total length (L1 + L2 + L3) of from about 30 mm to 50 mm.

According to a further embodiment, a blank mold V can be generated out of a starting part A according to figure 3 for production of a single piece axle, wherein the mold blank V as seen from the middle (only a very narrow first region 1) exhibits two mirror image forming narrowing regions 2 and cylindrical third regions 3 reduced in diameter and following to the regions 2. A further region 3a having an outer diameter D3 with reduced diameter is present at the two

ends. Here again the wall thickness is increased in the second regions 2 and in the third regions 3 and 3a in comparison to the starting wall thickness b1 in the first region (middle). The forming of the first region 1 and of the two second regions 2 of the axle As according to figure 4 is performed in the following by inner high-pressure metal forming. Cracks are avoided during the inner high-pressure metal forming based on the larger wall thickness in particular in the regions 2 of the blank mold obtained in the process of rotary kneading and sufficient material is furnished for continued flow. The transition from the deformed region 4 to the adjoining regions 3 sustains higher loads based on the larger wall thickness acting as a reinforcement.

Such hollow mold parts can be employed for example also in the production of gear parts in addition to the above described embodiment examples.

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of tubular system configurations and metal processing procedures differing from the types described above.

While the invention has been illustrated and described as embodied in the context of a hollow mold part with closed cross-section and reinforcement, it is not intended to be limited to the details shown, since various modifications and

structural changes may be made without departing in any way from the spirit of the present invention.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can, by applying current knowledge, readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention.

What is claimed as new and desired to be protected by Letters Patent is set forth in the appended claims.